

## **Title: Is Your Town Cool or Hot?**

### **Brief Overview:**

The students will determine the correlation between the latitude of a U.S. city and its average high temperature in July. They will also determine a relationship between the distance of a U.S. city from the coast and the variation of temperature between winter and summer. Data will be collected from the Internet and a U.S. map. The results will be organized, graphed, and interpreted by using spreadsheets.

### **Links to NCTM Standards:**

- **Mathematics as Problem Solving**  
Students will apply the process of mathematical modeling to discover the relationships that exist in real-world temperature patterns.
- **Mathematics as Reasoning**  
Students will make and test conjectures based on data collected from the Internet and/or a map and draw conclusions based on comparisons.
- **Mathematical Connections**  
Students will find the latitude of selected cities and make generalizations concerning location and its effect on the temperature.
- **Statistics**  
Students will enter geographical and temperature data into a spreadsheet and use the plotting function to obtain a scatter plot.
- **Function**  
Students will translate between the graphical and symbolic representations of a linear function.

### **Grade/Level:**

Grades 9-12

### **Duration/Length:**

This activity will take about 3 days on a regular schedule.

### **Prerequisite Knowledge:**

Students should have working knowledge of the following skills:

- Basic Internet research skills
- Map reading, measurement, and unit conversion

- Spreadsheet design and use
- Understanding and interpretation of linear variation
- Basic mathematical modeling skills

### **Objectives:**

Students will:

- work cooperatively in groups.
- collect and organize data from multiple resources.
- use a spreadsheet for input and graphical analysis.
- write a linear equation using the given data.
- express answers clearly in writing.
- interpret results and draw conclusions.

### **Materials/Resources/Printed Materials:**

- Computer with Internet access
- Pencils
- Scratch paper
- TI-82/83 graphing calculator (optional)
- Student worksheet(s) provided
- Teacher resources

### **Development/Procedures:**

- Review Internet access skills.
- Divide students into small groups.
- Follow self-directed worksheets.

### **Evaluation:**

Assessment will be based on the students' proficiency in collecting accurate data, compiling it into a spreadsheet format, and interpreting the results. Completed student worksheets will be collected and evaluated.

### **Extension/Follow Up:**

- Develop a mathematical model that would predict temperatures based on the influence of both latitude and distance from the ocean.
- Develop a mathematical model that would include the factors of latitude, distance from the ocean and elevation, and determine which factor has the greatest influence on the temperature.

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## STUDENT WORKSHEET

### Collecting data:

Log on.

Double click the Internet browser icon.

Collect **temperature** data by following these steps:

In the location box type:

**[http:// www.nbc4.com](http://www.nbc4.com)**

Click on **Weathernet 4**.

Click on **Intellicast**.

Click on **USA** to get a display of USA map.

Locate desired city on map and click.

Click on “**city almanac**” in the left column.

Copy average high temperatures for both **July** and **January** onto given chart on the following page.

Collect the **latitude** data by following these steps:

In the location box type:

**[http://lightning.ncdc.noaa.gov/nvds800\\_600n.html](http://lightning.ncdc.noaa.gov/nvds800_600n.html)**

When the map of the world appears, first zoom in on the US map. Select the desired city by carefully placing the pointer cross hairs on the small box representing that city. The latitude reading is located on the bottom left corner of the screen. Record the latitude readings in the chart provided on the following page.

Next, measure the **distance** in miles from each city to the nearest ocean. Use a ruler and a map and refer to the mileage legend. Record all distances into the chart.

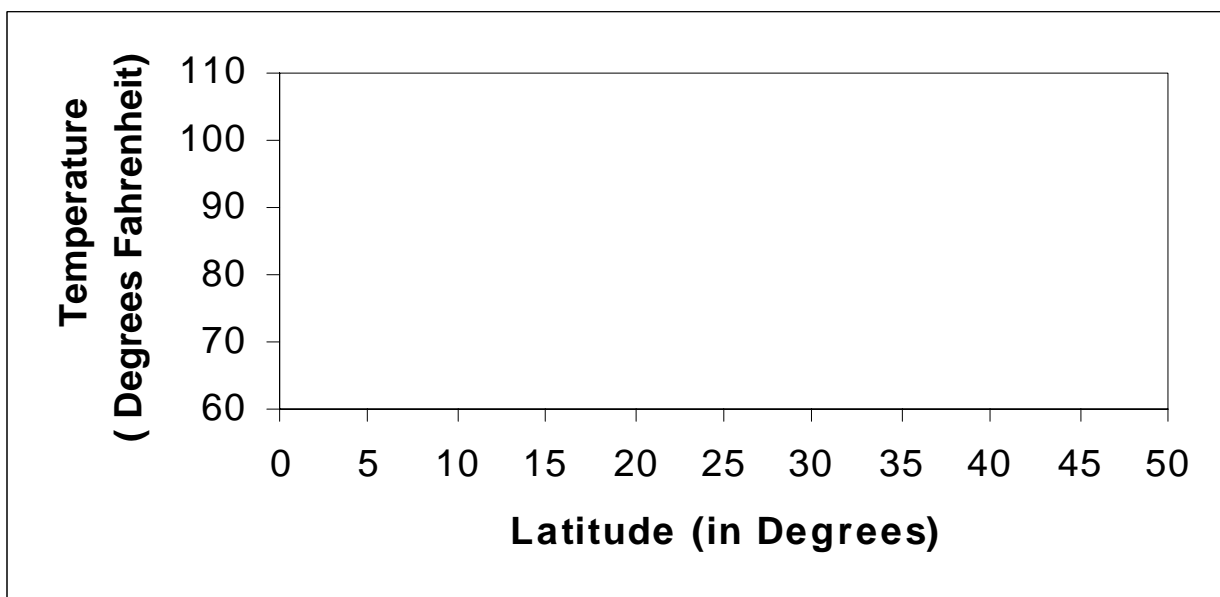
Enter all collected data from the chart on the following page into a spreadsheet. Use the chart wizard to produce the scatter plot graph of average high temperatures of July versus latitude on a Cartesian plane with temperature on the Y axis and latitude on the X axis.

	City	Latitude	Dist. from ocean	July Avg. High Temp.	January Avg. High Temp.
1	Boston, MA				
2	New York, NY				
3	Miami, FL				
4	New Orleans, LA				
5	Los Angeles, CA				
6	San Francisco, CA				
7	Seattle, WA				
8	Atlanta, GA				
9	Chicago, IL				
10	St. Louis, MO				
11	Dallas, TX				
12	Phoenix ,AZ				
13	Denver, CO				
14	Boise, ID				
15	Great Falls, MT				

## STUDENT QUESTIONS

1. Choose a minimum of four cities that seem to fit the general trend of the relationship found on the scatter plot graph. Graph them on the Cartesian plane provided below.

For the following three questions please refer to the scatter plot graph.



2. Analyze the graph and describe, using mathematical terms, the relationship you observe between the latitude and the temperature of a city.
3. Write the slope-intercept form of the equation of the line that describes the relationship between the average high temperature in July and latitude.
4. Formulate a "law" that describes the influence of latitude on temperature.
5. Use the equation obtained on #3 to create a new formula based column on your spreadsheet. Title this new column "model July temp." Create a second new column titled "error in model" that calculates the difference between the "model July temp." and the "July Avg. High temp" recorded in the chart above.

Which city has the highest value in the "error in model" column and what is that value?

6. In your opinion, could this model be used in predicting the average high July temperature of any other city in the US, given its latitude? Why?

7. Create a new column entitled “temp. variation” by calculating the difference between the “July Avg. High Temp” and “Jan. Avg. High Temp.” columns. Use the chart wizard to produce the scatter plot graph of “temp. variation” (Y axis) versus “dist. from ocean”(X axis).

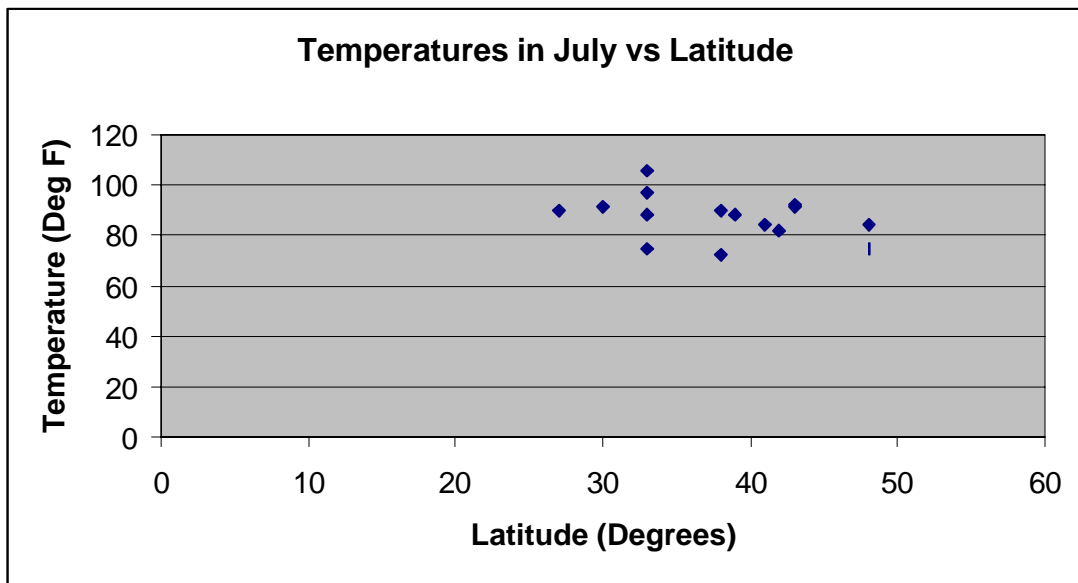
Analyze the resulting graph and describe any relationship that you may observe between the distance that city is from the ocean and the variation of its temperature from July to January.

8. Given the two factors, latitude and distance from the ocean, which of these two seems to have a more definite influence on the temperature of a city? What data/results seem to support your answer?

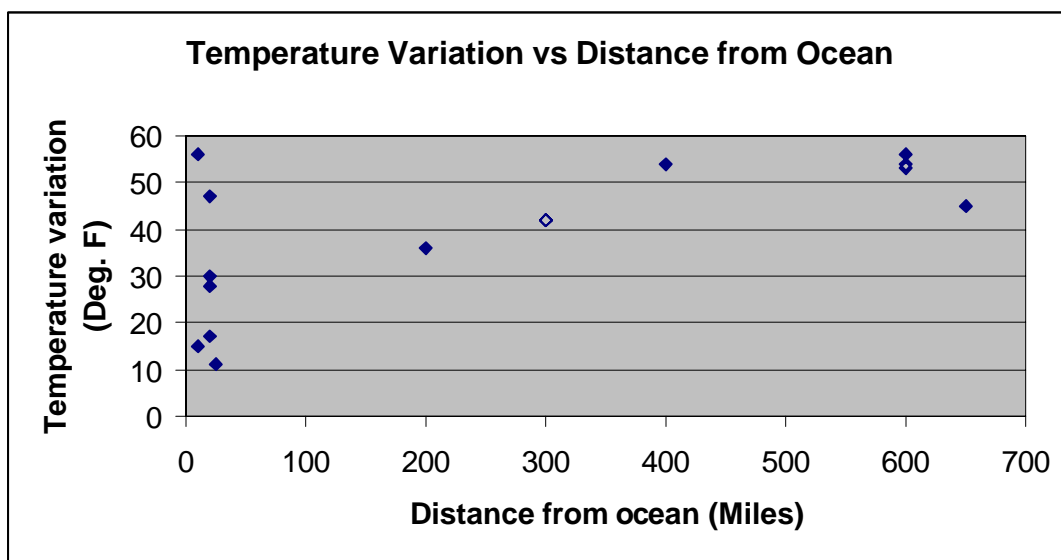
9. What do you think are some additional factors that might have some influence on the average temperature of a city.

## TEACHER RESOURCE MATERIAL

	City	Latitude	Dist. From Ocean	July Avg. High Temp.	Jan. Avg. High Temp.	Model July Temp.	Error in Model	Temp. Variation
1	Boston, MA	43	10	92	36	82.7	9.3	56
2	New York, NY	41	20	84	37	84.0	0.0	47
3	Miami, FL	27	10	90	75	92.9	-2.9	15
4	New Orleans, LA	30	20	91	63	91.0	0.0	28
5	Los Angeles, CA	33	25	75	64	89.1	-14.1	11
6	San Francisco, CA	38	20	72	55	85.9	-13.9	17
7	Seattle, WA	48	20	75	45	79.6	-4.6	30
8	Atlanta, GA	33	200	88	52	89.1	-1.1	36
9	Chicago, IL	42	600	82	28	83.4	-1.4	54
10	St Louis, MO	38	600	90	37	85.9	4.1	53
11	Dallas, TX	33	300	97	55	89.1	7.9	42
12	Phoenix, AZ	33	300	106	64	89.1	16.9	42
13	Denver, CO	39	650	88	43	85.3	2.7	45
14	Boise, ID	43	400	91	37	82.7	8.3	54
15	Great Falls, MT	48	600	84	28	79.6	4.4	56







### Possible Answers to Student Questions

Q.1. Choose a minimum of any four cities that seem to fit the general trend of the relationship found on the scatter plot graph. Graph them on the Cartesian plane provided below.

For the following three questions please refer to the scatter plot graph.

A.1. *See the graph titled Temperatures in July vs. Latitude (Answers may vary).*

Q.2. Analyze the graph and describe, using mathematical terms, the relationship you observe between the latitude and the temperature of a city.

A.2. *There seems to be an approximate linear relationship*

Q.3. Write the slope-intercept form of the equation of the line that describes the relationship between the average high temperature in July and latitude.

A.3. *The answers may vary, but the answer should be similar to:  $Y = -.636X + 110.08$ .*

Q.4. Formulate a “law” that describes the influence of latitude on temperature.

A.4. *The greater the latitude (further North, away from the equator), the lower the temperature.*

Q.5. Use the equation obtained on #3 to create a new formula based column on your spreadsheet. Title this new column “model July temp.” Create a second new column titled “error in model” that calculates the difference between the “model July temp.” and the “July Avg. High temp” recorded in the chart above. Which city has the highest value in the “error in model” column and what is that value?

A.5. *Answers may vary. In our model the answer is Phoenix, AZ, 16.9.*

Q.6. In your opinion, could this model be used in predicting the average high July temperature of any other city in the US, given its latitude? Why?

**A.6. Answers may vary. If there is not much of a discrepancy reflected in the “Error in Model” column the students should reason that the model can be used with a pretty reliable level of prediction. If there is a significant discrepancy (which is expected due to many other unaccounted for factors influencing the temperature), the students should reason that the model is not reliable and has a low predictability coefficient.**

Q.7. Create a new column entitled “temp. variation” by calculating the difference between the “July Avg. High Temp” and “Jan. Avg. High Temp.” columns. Use the chart wizard to produce the scatter plot graph of “temp. variation” (Y axis) versus “dist. from ocean” (X axis). Analyze the resulting graph and describe any relationship that you may observe between the distance that city is from the ocean and the variation of its temperature from July to January.

**A.7. There is no clear linear relationship between these two quantities.**

Q.8. Given the two factors, latitude and distance from the ocean, which of these two seems to have a more definite influence on the temperature of a city? What data/results seem to support your answer?

**A.8. Latitude seems to have a more significant influence in determining the temperature. The graphs indicate a more distinct linear relationship between temperature and latitude than between temperature and distance from the ocean.**

Q.9. What do you think are some additional factors that might have some influence on the average temperature of a city?

**A.9. Answers may vary, but they could include factors like: prevailing winds, elevation, nature of geographical surroundings (mountains, rivers, etc.), major water currents (Gulf stream, California current, etc.).**